

Docket No.: 491712000100
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re Patent Application of:

Eugene S. SMOTKIN

Application No.: 09/891,200

Filed: June 26, 2001

For: ELECTROLYTE COMPONENTS FOR USE
IN FUEL CELLS (AS AMENDED)

Confirmation No.: 9382

Art Unit: 1745

Examiner: Raymond Alejandro

BRIEF ON APPEAL

MS Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

A Notice of Appeal was filed in this case on 26 December 2006, thus setting a date for filing of the Brief of 26 February 2007. A petition for an extension of time of three (3) months until 26 May 2007 is enclosed along with the required fee. The rejection of claims 75-82 and 84-91 is the subject of this Appeal.

1. Real Party in Interest

The Real Party in Interest is the assignee herein, NuVant Systems LLC, a California corporation.

2. Related Appeals and Interferences

None of appellant, appellant's legal representative or assignee is aware of any prior or pending appeals, interferences or judicial proceedings that would be related to or otherwise affect the Board's decision in the pending appeal.

3. Status of Claims

This application was originally filed with 62 claims, all of which have now been canceled. Claims 63-74 were added in response to an Office action, response to which was filed 25 November 2003. These claims were canceled in response to the next Office action, which response was filed 23 July 2004, and claims 75-92 were added at that time. After filing an RCE, claims 75-92 were entered, but claims 83 and 92 were withdrawn from consideration. Claims 83 and 92 were canceled in a response filed 21 June 2005.

Thus, claims 1-74, 83 and 92 are canceled and claims 75-82 and 84-91 are pending and are on appeal.

4. Status of Amendments

There were no amendments proposed subsequent to final rejection in this case.

5. Summary of Claimed Subject Matter

Claims 75 and 84 are independent, and are alternative approaches to claiming similar subject matter.

The invention solves the problem of constructing electrolytes for fuel cell membrane electrode assemblies (MEA) that will operate at higher temperatures than those conventionally used. As explained on page 3 of the specification at lines 15-20, in conventional fuel cells, reactions are catalyzed on each face of a generally two-dimensional membrane that operates as the electrolyte. In order to function as an electrolyte in a fuel cell, such electrolytes must be electronically insulating but proton-conducting (EIPC) (see page 14, lines 10-11). The conductance of protons through the EIPC component must be sufficient to let the fuel cell of which the membrane electrode assembly is a member operate successfully.

The conductance can be calculated as the area of the electrolyte perpendicular to the flow of protons divided by the area specific resistance (ASR). (See the declaration of Dr. Smotkin submitted 9 January 2006, which outlines this textbook material.) Thus, the ASR, which is dependent on the thickness of the EIPC, must be sufficiently low to be workable in the fuel cell. A suitable range for of ASR protons as set forth on page 17, lines 3-4, is about $0.01\text{-}100\ \Omega\cdot\text{cm}^2$. A satisfactory level of proton ASR is also that represented by the conventional electrolyte Nafion[®] which operates at relatively low temperatures – *e.g.*, 80°C , as shown in Figure 10. This shows a similar but narrower and more favorable range compared to that set forth on page 17 – *i.e.*, about $0.02\text{--}0.15\ \Omega\cdot\text{cm}^2$. As noted in the application, Nafion[®] is successfully used as a proton-conducting polymer (see page 8, lines 4-9) but must operate at low temperature because the presence of water is required (see page 8, lines 9-14). Claim 75 specifies the area-specific resistance for protons in the above quoted range from page 17 and claim 84 specifies this area-specific resistance as referred to Figure 10. Figure 10 appears as such in the claims.

As noted in the specification on page 9, beginning at line 10, the desirability of having proton conductors working satisfactorily in the range of 200-500°C has been recognized in the art, but no successful electrolyte has been found (page 9, line 16-page 10, line 15). The invention proposes compositions for electrolytes that are workable in this general range. Specifically, as set forth in the claims and as supported, for example, on page 17, line 19-page 18, line 7, the specific temperature range of operability of 220°C-550°C is required. Both claims 75 and 84 require this temperature range.

As noted above, the area-specific resistance (ASR) for protons will increase as the thickness of an electrolyte increases. The data supplied in Norby, referred to on page 7, line 10, *et seq.*, of the present application, presents the conductivity of various materials as a function of temperature. Conductivity, unlike conductance, is an intrinsic property of the material and does not depend on thickness. Norby apparently assumes that the thickness of the EIPC electrolyte conventionally used in fuel cells is a required feature, and if that were true, only materials that had innate conductivities in the “gap” shown in Figure 1 of Norby would be satisfactory. The present inventor understood, as was not appreciated in the art, that in order to bring materials, such as those described by Norby, into a satisfactory level of proton ASR, it would be necessary to reduce the thickness of the electrolyte to such an extent that the electrolyte is no longer self-supporting, *i.e.*, the electrolyte does not remain intact because it is too thin. The present inventor further devised an appropriate solution to this problem by supporting the proton electrolyte on a metal foil.

Thus, this problem, unrecognized in the art, is solved by the invention, as described on page 23 of the specification beginning at line 7, by using a proton-conducting support. Metals or alloys can serve as separators of the fuel and oxygen that are the reactants in fuel cells and they

reversibly absorb hydrogen (see page 23, line 12). Thus, they become hydrides when the cells are in operation (see page 23, lines 14-16). Although they are electronic conductors, this is not problematic because the presence of the electrolyte as an electronic insulator makes this acceptable.

Thus, as set forth in claims 75 and 84, the invention is directed to electron-insulating proton-conducting (EIPC) membranes designed to serve as electrolytes in fuel cells where a single metal or metal hydride support is coated on one or both faces by an EIPC coating that operates at the above-cited temperature range (220-550°C) and at the appropriate proton ASR, *i.e.*, 0.01-100 $\Omega\cdot\text{cm}^2$, in claim 75 and in the range of Nafion[®] as shown in Figure 10 in claim 84.

The requirement that the EIPC be inorganic is supported on page 28, lines 11-12; additional alternatives are described, but only inorganic EIPC's are claimed. Support for lacking a liquid phase is found, for example, on page 22 at lines 10-12, page 21, lines 15-16, and page 11, lines 9-13, as well as lines 18-19.

Thus, support is found for the independent claims as described above.

The dependent claims simply name various materials that might be used to compose the metal/alloy support and the EIPC. Support for these embodiments is found, for example, on page 23, lines 10-11, with regard to the support, as well as page 27, lines 19-20. The specified EIPC's are found, for example, on page 29, beginning at line 6.

In summary, the invention resides in constructing an electrolyte that is useful in a membrane electrode assembly (MEA) for a fuel cell where operability at high temperatures is provided by use of an electrolyte that is inorganic and lacks a liquid phase. This is made possible in view of the realization by the present inventor that in order to achieve the requisite proton conductance or ASR of such materials, the electrolyte needs to be too thin to stand on its own and thus such electrolytes

must be supported on a metal/metal hydride support. While inorganic electrolytes are known in the art, their conductivity is so low that they have been considered as inappropriate for operation at the required temperatures by the practitioners of the art, as recognized by one of the documents of record herein, Norby. It has been found that satisfactory behavior at the relevant temperature range is only possible at thicknesses of the electrolyte which require such support, and this problem is solved by providing this support.

6. Grounds of Rejection to be Reviewed on Appeal

The following grounds of rejection, taken in order, are appealed.

Claims 84-91 were rejected under 35 U.S.C. § 112, paragraph 2, based on objection to the inclusion of a trademark designation and of a figure in claim 84.

Claims 75-76, 80-81, 84-85 and 89-90 were rejected as either anticipated (§ 102(b)) or obvious over Baucke, *et al.*, U.S. patent 5,094,927.

All pending claims, claims 75-82 and 84-91, were rejected as assertedly obvious over Smotkin, *et al.*, U.S. 5,846,669 in view of various secondary documents. These secondary documents are Norby, T., *Solid State Ionics* (1999) 125:1-11 (“Norby”); Crome, *et al.*, U.S. patent 5,985,113 (“Crome”); Ryu, Kwang Hyuan, *et al.*, *Solid State Ionics* (1999) 125:355-367 (“Ryu”); or Lybye, Dorthe, *et al.*, *Solid State Ionics* (1999) 125:339-344 (Lybye).

All claims were rejected as assertedly obvious over WO 98/21777 (“WO ‘777”) in combination with the same secondary documents as those listed above, also listed in the alternative.

7. Argument

Claim 84 and its Dependent Claims 85-91 Comply with 35 U.S.C. § 112, Paragraph 2.

The Examiner's objection to the inclusion of the Nafion[®] trademark in the language of the claim ignores the function served by the word "Nafion[®]" in this context. The Examiner might be correct if Nafion[®] were used to specify or describe a particular material or product; however, that is not the function of "Nafion[®]" in claim 84. In claim 84, Nafion[®] is simply a label on a depicted graph and the word Nafion[®] is used simply to refer to the label. It does not matter what the nature of Nafion[®] is in terms of the metes and bounds of the claim; it designates a region of proton conductance as shown. Thus, it is believed the use of this trademark in the present claim is proper.

The second basis for rejection of claim 84 (and presumably its dependent claims) is that the claim includes a figure where this incorporation is said by the Examiner not to be necessary as putatively evidenced by the alternative wording in claim 75. However, it will be noted that the range set forth in the graph of claim 84 is different from that mandated by claim 75; claim 75 mandates an area-specific resistance for protons (ASR) of 0.01-100 $\Omega\cdot\text{cm}^2$ whereas the range shown for Nafion[®] in Figure 10 has a lower limit somewhat greater than 0.01 $\Omega\cdot\text{cm}^2$ and an upper limit clearly lower than 100 $\Omega\cdot\text{cm}^2$. As the figure is the only place where this range for Nafion[®] is set forth in the specification, it is believed necessary to incorporate the figure into the claim in order to provide adequate support for this range.

The Examiner cites *Ex parte Fressola*, 27 USPQ2d 1608, 1609 (BPAI 1993) in support of his position. However, this case is clearly inapposite. This case involved an "omnibus" claim which reads as follows:

A system for the display of stereographic three-dimensional images of celestial objects as disclosed in the specification and drawings herein.

Appellant would certainly agree that this claim lacks clarity. However, it is in marked contrast to the present claim which itself sets forth the drawing and identifies the portion of the drawing that is relevant to the limitation of the claim. MPEP § 2173.05(s) pointed to by the Examiner is complied with as claim 84 is complete in itself; the claim does not incorporate by reference a figure or table, it displays the figure and pinpoints the elements of the figure that relate to the limitations of the claim.

Respectfully, appellant submits that claim 84 is in compliance with the relevant MPEP section and is consistent with the holding in *Ex Parte Fressola*.

The Rejection of Claims 75-76, 80-81, 84-85 and 89-91 as Assertedly Anticipated By or Made Obvious Over Baucke, et al., is in Error.

All claims subject to this rejection may be considered together.

As to anticipation, in order for anticipation to be found each and every limitation of the claim must be found explicitly or inherently in a single prior art document. *Bristol-Myers Squibb Co. v. Ben Venue Laboratories, Inc.*, 246 F3d 1368, 58 USPQ2d 1508 (Fed. Cir. 2001), citing *Celeritas Techs. Ltd. v. Rockwell Int'l Corp.*, 150 F3d 1354, 47 USPQ2d 1516 (Fed. Cir. 1998). Baucke fails to disclose a “single” metal or metal hydride support having one or both faces coated with an electron-insulating proton-conducting (EIPC) material as required both by claim 75 and by claim 84. The example cited by the Examiner refers to Figure 2 of Baucke which is an embodiment of a fuel cell (column 6, line 59). The depiction in Figure 2 shows both a hydrogen electrode (13) and an oxygen electrode (11). The oxygen electrode is composed of a nickel layer and the hydrogen electrode is also composed of a nickel layer covered on the gas side by a palladium layer. Thus, the

disclosure of Baucke discloses not a “single” metal or metal hydride support but instead two metal or metal hydride foils which in this case serve as electrodes, not as support for the electrolyte.

The requirement for a “single” metal foil support overcomes any accidental inherent anticipation. In addition, the “consisting essentially of” language in claims 75 and 84 distinguishes because the support of the invention would not include electrical connectors as would be required on the electrodes of Baucke.

The fact that the metal foils of Baucke serve as electrodes, not as supports, is also relevant to the issue of obviousness. In order to find obviousness, there must be some motivation or suggestion in the teachings of the document or in the art to modify the teachings so as to conform to the invention as claimed. *Sibia Neurosciences, Inc. v. Cadus Pharmaceutical Corp.*, 225 F3d 1349, 55 USPQ2d 1927 (Fed. Cir. 2000).

Here, there is not only no suggestion, but clear direction not to make any modification that would result in the invention as claimed. The claimed invention requires a “single” metal or metal hydride support. Baucke has two. As these serve as electrodes, Baucke’s apparatus would not even work if one of the electrodes were removed.

Respectfully, Baucke concerns a different construction altogether from that claimed in the present invention. Baucke describes hydrogen/oxygen fuel cells *per se* having electrolytes that are not supported by any supporting element, but rather sandwiched between two electrodes. There is no suggestion in Baucke that an electrolyte itself be supported by a metal or metal hydride support independent of the electrodes.

The Rejections of All Pending Claims Over Smotkin in View of Either Norby, Crome, Ryu or Lybye is in Error.

All of these rejections are based, as is evident, on Smotkin as a primary reference. The secondary references seem to be cited simply to show that some of the materials listed in claims 78-79 and claims 87-88 were known as proton-conducting electron-insulating (EIPC) materials prior to the time of the invention. There is no quarrel with this. The cited prior art is clear that there were problems with using these very materials as electrolytes absent the innovation of the present invention.

For example, Norby mentions BCN18 and CsHSO₄ as EIPC's, but notes that they are not useable at the temperatures in the temperature range set forth in the claims, because, as understood only by the appellant, the thickness required to provide sufficient support to the electrolyte intact, and apparently thought to be a necessary feature by Norby, results in too high an area-specific resistance to make them useful. Thus, as to BCN18 and CsHSO₄, the thicknesses apparently assumed necessary in Norby are such that the ASRs of these materials are inappropriate. As Norby says on page 4, "there are no solid proton conductors working satisfactorily in the gap between, say, 200 and 500°C shown in Figure 1." Thus, Norby explicitly teaches away from using the disclosed materials in the required temperature range.

In the primary document, Smotkin, the Examiner refers to Figure 1 thereof which discloses a fuel cell having an anode and a cathode, and two portions of an electrolyte, one portion being acidic and the other basic. These are separated by a proton-permeable barrier (17) that is a foil of a metal hydride. The Examiner thus concludes that the metal hydride foil acts as a support which is coated on both sides by the electrolyte-containing matrices which, he says, represent the inorganic/composite [sic] non-liquid material. The Examiner thus asserts that the proton-permeable

barrier (17) can be seen as a support for the electrolytes, so that Smotkin somehow suggests the invention as claimed.

Were this a rejection for anticipation, the desired function of the metal foil (17) would be irrelevant. However, no anticipation can be found because the electrolyte, far from lacking a liquid phase, mandates a liquid phase in each case. Since no anticipation can be found, and the document is cited only for what it suggests, rather than for any accidental anticipation, the function of the metal foil is entirely relevant.

There is no suggestion in Smotkin that the metal foil be used as a support for the acidic and basic electrolytes. They do not need any support. The metal foil instead serves as a barrier to prevent liquids from exchanging between the two compartments.

It is difficult to see why Smotkin would suggest modifying the fuel cell described so as to provide electrolytes that contain no liquid phases, and to then retain the metal foil since, according to Smotkin, if there were no liquid phases, there would be no need for a barrier and therefore no need for the foil. Smotkin does not recognize the problem solved by the invention, because the fuel cell described by Smotkin does not have this problem. It has another problem altogether – mixing of liquids in the electrolyte.

As noted above, the first secondary reference cited by the Examiner, Norby, actually teaches away from the use of the materials there described as electrolytes in fuel cells at high temperatures. Norby specifically states that the materials disclosed are unsuitable and suggests that materials with conductivities in the gap area be found. None of the materials in Norby, of course, have conductivities in Norby's "gap."

Crome is cited for describing the use of scandium-containing compounds or gallium-containing compounds in electrolytes, which the Examiner claims are interchangeable. Actually, none of the materials described by Crome are mentioned in claims 78-79 or 87-88 so the relevance of Crome is not clear on that basis alone. The material listed in Crome that is most similar to one of the materials listed in claims 78-79 and 87-88 ($\text{La}_{0.9}\text{Sr}_{0.1}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$) is $\text{La}_{1-x}\text{Sr}_x\text{Ga}_{1-y}\text{Mg}_y\text{O}_3$. This material is listed not as a proton conductor but as an oxide conductor in the oxygen-generating systems of Crome.

Ryu is just a study of blends that result in a formula set forth in claims 78, 79, 87 and 88 as the last-mentioned inorganic material, but there is no suggestion in Ryu that in order actually to use this material under the invention conditions – i.e., to obtain satisfactory a ASR, the material would have to be so thin that a support would be required. Ryu is oblivious of such parameters. Ryu is just an academic study of the stability of the material to decomposition *versus* its conductivity. So Ryu provides no reason, if this electrolyte were to be used in the configuration of Smotkin, to retain the metal barrier in the electrolyte.

Like Ryu, Lybye discloses a doped material that is listed in the present claims, but only in regard to its ability to conduct oxide ions, not protons.

The only reason cited by the Examiner for combining Smotkin with the secondary documents is that “they all address the same problem of providing suitable membrane components *“per se.”* Strictly speaking, this is not true. All the Examiner is saying, really, is that both the primary and secondary documents concern fuel cells and electrolytes. This seems insufficient as reason to combine. Using the invention as a guide to combine documents is still impermissible hindsight under *KSR International v. Teleflex, Inc.*, 82 USPQ2d 1385 (S. Ct. 2007). And that is

precisely what the Examiner has done. If the electrolytes disclosed in Smotkin were replaced by electrolytes of the invention that contain no liquid, Smotkin would suggest removal of the foil used as a barrier. Smotkin teaches there would be no need to retain the metal barrier that was placed in the electrolyte precisely to prevent the exchange of liquids. Smotkin thus teaches away from combining its configuration with the materials described in the secondary documents.

The Rejection of All Claims Over the Combination of WO '777 with Norby, Crome, Ryu or Lybye is also in Error.

WO '777 is in German, but there is a U.S. counterpart issued patent which is in English. Appellant has consistently referred to this English translation, although the Examiner appears to persist in citing only the English abstract and Figure 1 of the German language document. The corresponding U.S. patent is U.S. 6,242,122.

The rejection is cast as a rejection under § 103 over the combination of WO '777 with Norby, Crome, Ryu or Lybye. However, the rationale for the rejection appears to assert that as to claims 75, 82, 84 and 91, at least, WO '777 somehow inherently anticipates the present invention. The Examiner asserts that the claims cover a very large number of materials and thus, the materials described by WO '777 are included within the scope of the claims. The Examiner further asserts that the area-specific resistance (ASR) would necessarily be that required by the claims in view of "extrinsic evidence." Applicant is unaware of any extrinsic evidence of record. There is nothing in WO '777, certainly, that suggests or implies that the required ASR in the required temperature range would be exhibited by the apparatus described in this document.

Further, in the exemplified embodiment of the apparatus in WO '777 Figure 1, as explained in the '122 patent, the electrolytes of (4) and (6) are polymers, and are thus necessarily organic

materials. The present claims require the electrolyte to be an inorganic material that contains no liquid phase.

The Examiner cites MPEP § 2112 for the proposition that

Once a reference teaching product appearing to be substantially identical is made the basis of a rejection, and the Examiner presents evidence or reasoning tending to show inherency, the burden shifts to the applicant to show an unobvious difference.

However, here, the Examiner has presented no reasoning or evidence to show inherency, and furthermore, has neglected the section preceding the statement quoted, which makes it clear that such reasoning and/or evidence must be presented by the Examiner. MPEP § 2112 IV states:

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic.

Citing *In re Rijckaert*, 9 F3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993)

and *In re Oelrich*, 666 F2d 578, 581-582, 212 USPQ 323, (CCPA 1981).

One of the cases cited in this section may be instructive – *In re Robertson*, 169 F3d 743, 745, 49 USPQ2d 1949, 1950-1951 (Fed. Cir. 1999). The claim at issue provided for two mechanical fastening means to attach the diaper to the wearer and a third means for securing the diaper for disposal. The cited reference did not disclose a separate fastener, but the Board had found that the third fastening element could be inherent in the cited disclosure because it would have been possible to attach the first and second fastening elements to each other, thus forming the third element. Indeed, the claim at issue did not specifically require a “separate” third fastening means. In reversing a finding of any inherent anticipation, the majority said:

To establish inherency, the extrinsic evidence “must make clear that the missing descriptive matter is necessarily present in the thing

described in the reference and that it would be recognized by persons of ordinary skill.”

Citing *Continental Can Co. v. Monsanto Co.* (supra), 948 F2d 1264, 1268, 20 USPQ2d 1746 (Fed. Cir. 1991).

The *Robertson* decision also states that any inherent anticipation must be inevitable:

Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

Citing *Continental Can co. v. Monsanto Co.* (supra); *In re Oelrich*, 666 F2d 578, 212 USPQ 323 (CCPA 1981).

Based on this standard, no *prima facie* case, as required by MPEP 2112 IV has been made.

The polymeric coatings of WO ‘777 are clearly different from the inorganic coating of the present claims, and there is no reason to think that the ASR at the required temperature range would be that of the present claims either. As to the Examiner’s second point – that the preamble does not serve as a limitation, this appears irrelevant as WO ‘777 does describe, among other things, an electrolyte.

However, the Examiner has not indicated that the rejection is based on anticipation, and has treated the rejection as an obviousness rejection over a combination of WO ‘777 with the same secondary documents as were applied with respect to Smotkin.

Although the Examiner has not noted it, in column 1, lines 13-15, the ‘122 patent corresponding to WO ‘777 states that potentially suitable electrolytes include membranes or other solid electrolytes, *e.g.*, made of ceramic material, or liquid electrolytes.

The mention of ceramic electrolytes in this context does not meet the claim limitations in view of the further discussion in the ‘122 patent, since the claims require that “the inorganic

material contains no liquid phase.” As is made clear by the ‘122 patent, as noted in the following paragraph, the electrolytes must necessarily contain a liquid phase.

The problem solved by the arrangement in the ‘122 patent is said to be that not only are the ions (hydrogen ions) able to pass through the electrolyte, but also the hydrate shells of the hydrogen ions that are part of the fuel. In the case of methanol-consuming fuel cells exemplified by ‘122, the electrolyte is permeable to methanol molecules (column 1, lines 43-48). Further, the “entrainment of water causes the anode to dry out, leading to reduced output” (column 1, lines 54-55). Thus, there must be water present or methanol present in the electrolyte described by the ‘122 counterpart to WO ‘777.

The arrangement described in Figure 1 is to employ two electrolyte layers between which a single or multilayer barrier layer is disposed. In the discussion of the rejection, the Examiner sees this barrier layer (which is made of a palladium silver alloy) as the single metal or metal hydride support of the claims and seems to assume that the two electrolyte layers meet the remaining claim limitations. As noted above, they do not. They necessarily contain liquid phases, and Figure 1 is described as involving polymer membrane electrolytes, which are not inorganic. There is no evidence of record that the ASR meets the claim limitations at the required temperature range. And there is no direct assertion, even by the Examiner, that the subject matter of claims 75, 82, 84 and 91 is anticipated by WO ‘777; the rejection is made for obviousness over a combination of WO ‘777 with either Norby, Crome, Ryu, or Lybye.

In support of the combination of WO ‘777 with Norby, the Examiner asserts that it would be obvious to use the specific proton conductor material of Norby on the metal substrate base of WO ‘777, because Norby “discloses that such specific proton conductor materials are suitable solid

state protonic conductors which can be used in fuel cell applications such as hydrogen permeable membranes.” But Norby does not teach that these materials can be used as electrolytes with an ASR for protons in the specified range between 220°C and 550°C. Indeed, Norby teaches exactly the opposite – “that there are no solid proton conductors working satisfactorily in the gap between say 200 and 500°C as shown in Figure 1.” (See page 4, left-hand column, six lines from the bottom.)

Oddly, the claims that include the materials described by Norby, claims 78-79 and 87-88, are not even discussed in the context of the rejection combining WO ‘777 with Norby.

The rejection combining WO ‘777 with Crome follows the same pattern. WO ‘777 has been discussed above. Again, the specific claims which disclose particular electrolytes are not discussed in the rejection, although claim 31, which does not appear in the present application, is referred to. The Examiner refers to column 9, lines 24, *et seq.*, which describe as a electrolyte a composite of lanthanum, strontium, gallium, and magnesium as an oxide which presumably is similar to the listing in claims 78, 79, 87 and 88 of $\text{La}_{0.9}\text{Sr}_{0.1}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$. But electrolyte included in these claims does not contain gallium, but rather scandium. The Examiner therefore states that Crome envisions that scandium can replace gallium in the ceramic composite, citing lines 10-26 of column 9. Applicant is unable to find such a statement at this location in Crome.

In any event, even if Crome were to describe the listed substance as a possible electrolyte, it is not seen how there is any reason available in the art use it to replace the polymeric membrane used in WO ‘777. For one thing, Crome describes an oxygen generator and the electrolytes described are not proton conductors but oxide ion conductors. Second, the electrolytes described by Crome are actually structural supports for the electrodes which are coated on either side of them.

The electrolytes described by Crome would necessarily be thick enough to serve as the supports themselves, and would not require the metal barrier described in WO '777 either as a support or as a barrier to liquid flow.

The discussion by the Examiner regarding the combination of WO '777 with Ryu is similar. WO '777 has been discussed above. Again, the claims containing specific electrolytes are never discussed in the context of this rejection although they are included in the initial statement thereof. Ryu lists one of the electrolytes specifically mentioned in claims 78-79 and 87-88 – $\text{BaCe}_{0.9-x}\text{Zr}_x\text{M}_{0.1}\text{O}_{3-\delta}$. The Examiner asserts that Ryu teaches that this composition “gives a good compromise between conductivity and stability for fuel cell applications.” This appears to be quoted from the abstract.

But there is no teaching in Ryu that would lead one to place this material in the specific configuration of WO '777; Ryu is simply a generic teaching that this material might be used in a fuel cell in general. There is no hint that if one were to do so, a metal foil support would be required.

The rejection of all claims over the combination of WO '777 in combination with Lybye follows the same pattern. Again, although no specific mention is made of claims 78-79 and 87-88, the article concerns one of the possible electrolytes listed ($\text{La}_{0.9}\text{Sr}_{0.3}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$). The Examiner concludes that the publication teaches that this compound “exhibits excellent proton conduction at temperatures below 700°C.” It is not clear what location in the publication the Examiner is quoting. The conclusion of Lybye states simply that “at temperatures below 700°C, proton conduction dominates while above 800°C oxide ion conduction becomes increasingly dominant.” It is unclear from Lybye whether the conductivity of this material is indeed satisfactory in fuel cells and under

what conditions of thickness. Lybye states the purpose of the study is to search “for new and better oxide ion conductors for use as electrolytes in solid oxide fuel cells” (page 339, left-hand column).

Regardless of whether $\text{La}_{0.9}\text{Sr}_{0.3}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$ is useful somehow as a proton conductor, there is clearly no suggestion in Lybye that this electrolyte be used in any configuration described in Figure 1 of WO ‘777 or that it would require the support of the invention.

In summary, there is no explicit rejection for inherent anticipation by WO ‘777, and there can be no supportable rejection on this basis. The rejection as articulated requires combination of WO ‘777 with any one of several secondary documents. As was the case for Smotkin, because there is no inherent anticipation, the purpose of the metal foil described in WO ‘777 is significant – in this case, to serve as a barrier to prevent the passage of methanol, similar to the purpose of Smotkin to prevent the exchange of liquids. If the inorganic materials described in the secondary references were to be substituted into WO ‘777, there would be no point in retaining the metal foil, from the standpoint of the teachings of the primary document. Therefore, the invention as claimed does not result even if the documents are combined.

For these reasons, the rejection over WO ‘777, in combination with various secondary documents, should be withdrawn, and appellant requests withdrawal of this basis for rejection.

Conclusion

Respectfully, appellant requests that the rejections of claims 75-82 and 84-91 be reversed and these claims be passed to issue.

8. Claims Appendix

An Appendix containing a copy of the claims as currently pending is attached.

9. Evidence Appendix

Attached is an Appendix which lists and includes copies of evidence of record.

10. Related Proceedings Appendix

There are no related proceedings, therefore no Appendix is included.

The Assistant Commissioner is hereby authorized to charge any additional fees under 37 C.F.R. § 1.17 that may be required by this Brief, or to credit any overpayment, to **Deposit Account No. 03-1952.**

Dated: May 29, 2007

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CLAIMS APPENDIX

1-74. (canceled)

75. (previously presented): A proton-conducting membrane designed to serve as an electrolyte in a fuel cell, which membrane consists essentially of
a single metal or metal hydride support, wherein
one or both faces of said support is coated with an electronically-insulating proton-conducting coating, which coating consists of an inorganic material that contains no liquid phase, said coating having a thickness such that the area-specific resistance for protons is in the range of $0.01\text{-}100\ \Omega\cdot\text{cm}^2$ at at least one temperature between 220°C and 550°C .

76. (previously presented): The membrane of claim 75, wherein the metal or the metal contained in the metal hydride is palladium, titanium, silver, copper, vanadium, lanthanum, nickel, iron, chromium or alloys thereof.

77. (previously presented): The membrane of claim 76, wherein the metal or metal in the metal hydride is selected from the group consisting of Pd, PdAg, PdCu, Ti, LaNi_5 , TiFe and CrV_2 , V/Ni/Ti, V/Ni and V/Ti.

78. (previously presented): The membrane of claim 75, wherein the electronically-insulating proton conductor coating is selected from the group consisting of:

mesoporous zirconium phosphate pyrophosphate, $\text{Zr}(\text{P}_2\text{O}_7)_{0.81}$;

$\text{Ba}_3\text{Ca}_{1.18}\text{Nb}_{1.82}\text{O}_{8.73}\cdot\text{H}_2\text{O}$;

$\text{Cs}_5\text{H}_3(\text{SO}_4)_4\cdot 0.5\text{H}_2\text{O}$;

a hydrate of SnCl_2 ;

silver iodide tetratungstate $\text{Ag}_{26}\text{I}_{18}\text{W}_4\text{O}_{16}$;

KH_2PO_4 ;

tetraammonium dihydrogen triselenate, $(\text{NH}_4)_4\text{H}_2(\text{SeO}_4)_3$;

CsDSO_4 ;

CsH_2PO_4 ;

$\text{Sr}[\text{Zr}_{0.9}\text{Y}_{0.1}]\text{O}_{3-\delta}$;

a silica-polyphosphate composite containing ammonium ions;

$\text{La}_{0.9}\text{Sr}_{0.1}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$; and

$\text{BaCe}_{0.9-x}\text{Zr}_x\text{M}_{0.1}\text{O}_{3-\delta}$ where M is Gd or Nd and $x = 0$ to 0.4 .

79. (previously presented): The membrane of claim 75, wherein the electronically-insulating proton-conducting coating consists of

$\text{Ba}_3\text{Ca}_{1.18}\text{Nb}_{1.82}\text{O}_{8.73}\text{-H}_2\text{O}$;

CsH_2PO_4 ;

$\text{Sr}[\text{Zr}_{0.9}\text{Y}_{0.1}]\text{O}_{3-\delta}$;

polyphosphate composite containing 19.96 wt% NH_4^+ , 29.3 wt% P, 1.51 wt% Si;

$\text{La}_{0.9}\text{Sr}_{0.1}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$; or

$\text{BaCe}_{0.9-x}\text{Zr}_x\text{M}_{0.1}\text{O}_{3-\delta}$ where M is Gd or Nd and $x = 0$ to 0.4 .

80. (previously presented): The membrane of claim 75, wherein the thickness of the metal or metal hydride is 5-1,000 μm .

81. (previously presented): The membrane of claim 80, wherein the thickness of the metal or metal hydride is 10-200 μm .

82. (previously presented): The membrane of claim 75, wherein the area-specific resistance for protons at at least one temperature between 220°C and 550°C is about 0.150 $\Omega\cdot\text{cm}^2$.

83. (canceled)

84. (previously presented): A proton-conducting membrane designed to serve as an electrolyte in a fuel cell, which membrane consists essentially of a single metal or metal hydride support, wherein one or both faces of said support is coated with an electronically-insulating proton-conducting coating, which coating consists of an inorganic material that contains no liquid phase, said coating having a thickness such that the ASR for protons at at least one temperature between 220°C and 550°C is in the range shown for Nafion® 117 in Figure 10:

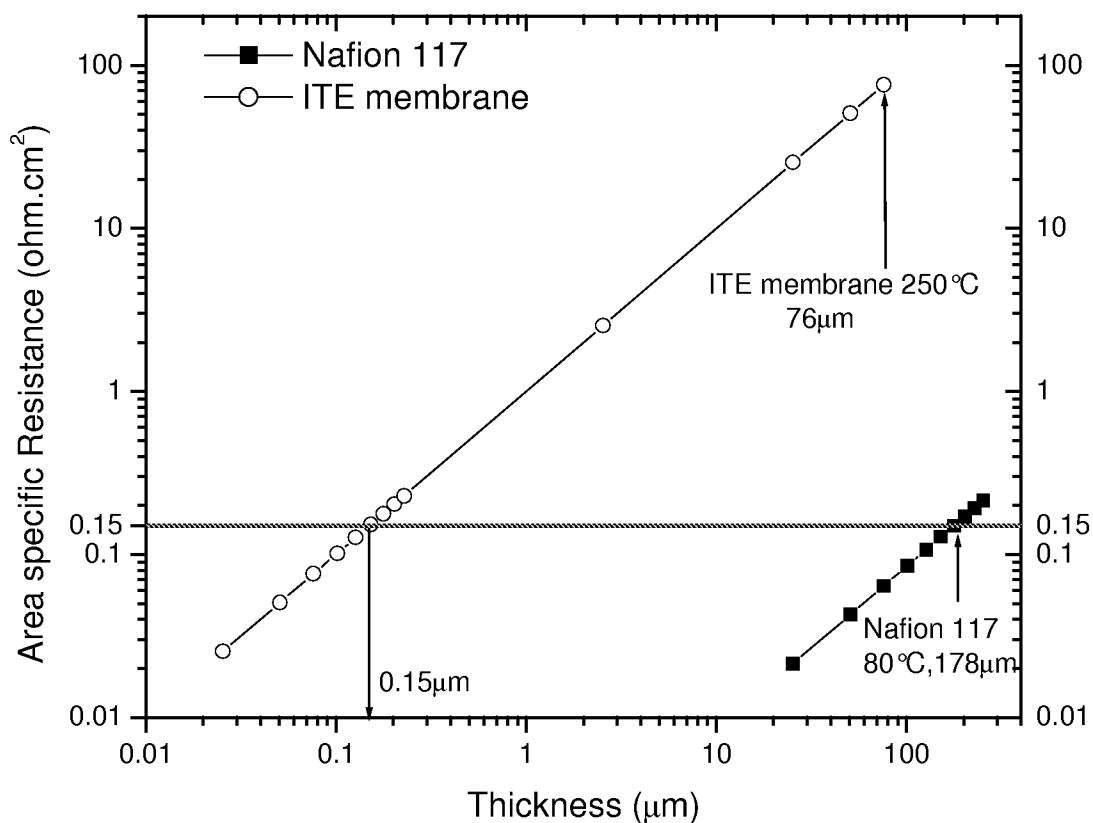


Figure 10.

85. (previously presented): The membrane of claim 84, wherein the metal or the metal contained in the metal hydride is palladium, titanium, silver, copper, vanadium, lanthanum, nickel, iron, chromium or alloys thereof.

86. (previously presented): The membrane of claim 85, wherein the metal or metal in the metal hydride is selected from the group consisting of Pd, PdAg, PdCu, Ti, LaNi₅, TiFe and CrV₂, V/Ni/Ti, V/Ni and V/Ti.

87. (previously presented): The membrane of claim 84, wherein the electronically-insulating proton-conducting coating is selected from the group consisting of:

mesoporous zirconium phosphate pyrophosphate, Zr(P₂O₇)_{0.81};

Ba₃Ca_{1.18}Nb_{1.82}O_{8.73}-H₂O;

Cs₅H₃(SO₄)₄·0.5H₂O;

a hydrate of SnCl₂;

silver iodide tetratungstate Ag₂₆I₁₈W₄O₁₆;

KH₂PO₄;

tetraammonium dihydrogen triselenate, (NH₄)₄H₂(SeO₄)₃;

CsDSO₄;

CsH₂PO₄;

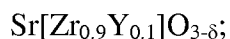
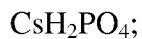
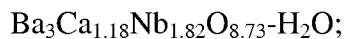
Sr[Zr_{0.9}Y_{0.1}]O_{3-δ};

a silica-polyphosphate composite containing ammonium ions;

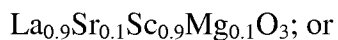
La_{0.9}Sr_{0.1}Sc_{0.9}Mg_{0.1}O₃; and

BaCe_{0.9-x}Zr_xM_{0.1}O_{3-δ} where M is Gd or Nd and x = 0 to 0.4.

88. (previously presented): The membrane of claim 84, wherein the electronically-insulating proton-conducting coating consists of



polyphosphate composite containing 19.96 wt% NH_4^+ , 29.3 wt% P, 1.51 wt% Si;



89. (previously presented): The membrane of claim 84, wherein the thickness of the metal or metal hydride is 5-1,000 μm .

90. (previously presented): The membrane of claim 89, wherein the thickness of the metal or metal hydride is 10-200 μm .

91. (previously presented): The membrane of claim 84, wherein the area-specific resistance for protons at at least one temperature between 220°C and 550°C is about 0.150 $\Omega\cdot\text{cm}^2$.

92. (canceled)

EVIDENCE APPENDIX

This appendix contains, for the convenience of the Office, the following evidentiary material already of record:

1. The Declaration of Eugene S. Smotkin under 37 C.F.R. § 1.132, explaining the technical background for the invention.
2. A printout from Google™ illustrating the well known nature of Nafion® 117.
3. An abstract by Stewart, F. F., describing Nafion® 117 developments in thermochemical and electrolytic routes to hydrogen production part II (14008) (2005).
4. An article by Sheppard, S. A., *Analyst* (1998) 123:1923-1929.
5. A page from the New Car Buyers Guide of November 2004.